NEOTROPICAL BIOLOGY AND CONSERVATION

Neotropical Biology and Conservation 18(3): 119–129 (2023)
DOI: 10.3897/neotropical.18.e103070

Research Article

Productivity and impact of the Unisinos' Postgraduate Program in Biology and the consequences of its interruption for Brazilian science

Piter Kehoma Boll[1], Lucas Krüger[2,3]

1 *Programa de Pós-Graduação em Biologia, Universidade do Vale do Rio dos Sinos, UNISINOS, São Leopoldo, RS, Brazil*
2 *Instituto Antártico Chileno, Plaza Muñoz Gamero 1055, Punta Arenas, Chile*
3 *Instituto Milenio Biodiversidad de Ecosistemas Antárticos y Subantárticos (BASE), Las Palmeras 3425, Ñuñoa, Santiago, Chile*
Corresponding author: Lucas Krüger (lkruger@inach.cl)

Abstract

On 22 July 2022, the Universidade do Vale do Rio dos Sinos (Unisinos), a private institution and community university in southern Brazil, announced the interruption of 12 of its postgraduate programmes, including the Postgraduate Program of Biology (PPG Biologia), whose professors founded the journal, Neotropical Biology and Conservation. We conducted a bibliometric analysis of papers published by PPG Biologia in the past 20 years to assess its impact on biological research at a national level. The number of publications and citations increased constantly over the years, with publications growing exponentially. Although most collaborations with other research programmes occurred inside Brazil, a significant number of studies were co-authored by researchers from other countries from at least four continents. The main research lines focused on biological sciences, ecology, sociology, education, environmental sciences and genetics. Despite being affected by the decrease in research funding and the reduction of personnel, PPG Biologia kept its high impact score according to the national evaluation, above that of most programmes in private universities and similar to public ones. With a team of renowned researchers working on different and sometimes unique research lines, the interruption of PPG Biologia will harm the progress of biological research and conservation across the Neotropical realm.

Key words: Bibliometric, biodiversity loss, Brazil, environmental crisis, political crisis, publications

OPEN ACCESS

Academic editor: Heloísa Allgayer
Received: 6 March 2023
Accepted: 24 July 2023
Published: 27 September 2023

Citation: Boll PK, Krüger L (2023) Productivity and impact of the Unisinos' Postgraduate Program in Biology and the consequences of its interruption for Brazilian science. In: Boll P, Lehmann A. P, Allgayer H, Krüger L (Eds) Diversity and Wildlife Management: The legacy of PPG Biologia Unisinos. Neotropical Biology and Conservation 18(3): 119–129. https://doi.org/10.3897/neotropical.18.e103070

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Introduction

In Brazil, Biodiversity research occurs in both public and private institutions, but, even in private ones, it relies almost entirely on governmental funding (Mittermeier et al. 2005; McManus and Baeta Neves 2021), which has been in constant turmoil (Magnusson et al. 2018; Quintans-Júnior et al. 2020). Biodiversity science suffered severe budget cuts by the Brazilian government in recent years, driven by politicians associated with the agribusiness sector (Fearnside 2016; Magnusson et al. 2018). Agribusiness controls a large proportion of the Brazilian Congress and pushes legislation to reduce environmental protection

(Crouzeilles et al. 2017), actively discrediting science through direct attacks on researchers, science denial and misinformation (Hallal 2021). The situation became even worse during the administration of Jair Bolsonaro, who attacked and denied science himself (de Oliveira Andrade 2019; Hallal 2021), when a significant dismantling of environmental laws took place in the country, leading to an increase in deforestation, especially in the Amazon Rainforest and release of pesticides (Barbosa et al. 2021).

With the increasing precariousness of science funding in Brazil, the discontinuation of consolidated high-prestige research programmes became an additional threat to research (de Oliveira Andrade 2019; Hallal 2021), as many institutions have groups working on unique and important research lines. This is the case of the Postgraduate Program in Biology (PPG Biologia) of the Universidade do Vale do Rio dos Sinos (Unisinos), located in São Leopoldo, southern Brazil. Despite being a private institution, Unisinos is considered a community university (https://www.unisinos.br/institucional), which means it is maintained by civil society and should contribute to the country's development by offering high-quality education, including postgraduate programmes.

On 22 July 2022, Unisinos announced the interruption of PPG Biologia and other 11 postgraduate programmes. This decision, according to the institution, aims to promote the University's financial balance (Ferreira 2022), but is a serious attack on Brazilian research, as well as an affront to its status as a community university. PPG Biologia was implemented in 2000 with a course for Master's Degrees and, in 2006, expanded to include Doctoral Degrees as well. Additionally in 2006, PPG Biologia launched the journal Neotropical Biology and Conservation, which replaced the journal Acta Biologica Leopoldensia, created in 1979 by professors of the Unisinos' Biology course (Maltchik 2006). The programme had 13 fully equipped research laboratories led by highly qualified ecologists, zoologists, geneticists and microbiologists, including research lines focused on taxonomy, currently one of the most neglected areas of biological knowledge in Brazil and the world. The taxonomic research included groups such as plants, fish, arachnids and flatworms. The discontinuation of PPG Biologia interrupted the research of many professors and graduate students and will likely have a noticeable negative impact on Brazilian biological research.

Measuring the importance of this postgraduate programme can help us understand better the consequences of its discontinuation. Thus, we herein conducted a bibliometric analysis of papers published by PPG Biologia in the past 20 years to assess its impact on biology research at a national level, evaluating production and collaborations and comparing overall performance with other Brazilian institutions.

Methods

We ran a bibliographical review on the Dimensions platform (https://app.dimensions.ai/). Dimensions is the "world's largest research information dataset" with over 130 million publications registered, classified and described on a standardised methodology (Bode et al. 2019). The term "Programa Pós-graduação Biologia Unisinos" (Portuguese for "Unisinos Postgraduate Program

in Biology") was searched anywhere in the documents, as it could be mentioned in the authors' affiliations and acknowledgment sections.

We measured the impact of PPG Biologia by the number of publications per year and the cumulative citations using the R packages 'dimensionsR' (Aria 2022) and 'bibliometriX' (Aria and Cuccurullo 2023). To test whether there has been a sustained temporal increase in production, number of citations and accumulated number of citations, we applied simple or exponential linear models in R (R Core Team 2022).

Text processing and analytics were used to convert text data into quantification data, using the R packages 'tidytext' (Robinson and Silge 2023) and 'tm' (Feinerer and Hornik 2023). That procedure was applied to identify the collaboration of researchers from PPG Biologia with researchers from other institutions based on nationality and the research areas of the publications. We used a circular network and a bipartite network to describe a network of countries with co-authorship and co-authorships in different research areas, respectively, using the R packages 'ggraph' (Pedersen 2022) and 'bipartite' (Dormann et al. 2022). A word cloud (Lang and Chien 2022) was applied using the frequency of keywords from papers published between 2015 and 2021 to identify the main topic of publications.

Postgraduate programmes (PGs) in Brazil are classified by CAPES (Portuguese acronym for Coordination for the Improvement of Higher Education Personnel), which conducts annual evaluations of the PGs' performance based on their impact, such as productivity and personnel formation (Cross et al. 2017). We downloaded data from 2013 to 2020 of all Brazilian PGs in Biological Sciences (389 PGs for the period) from https://dadosabertos.capes.gov.br/dataset/. We used two separate Wilcox tests to compare the performance of Unisinos with public and private institutions.

Data and script were provided in Krüger (2023).

Results

The productivity of PPG Biologia (Fig. 1a) increased exponentially (adj. $R^2 = 0.898$, $F_{1,26} = 23.91$, $P < 0.001$) from less than 10 peer-reviewed publications per year in 1999 to over 300 publications per year in 2022. Citations per year (Fig. 1b) increased on a weak, but significant linear trend (adj. $R^2 = 0.233$, $F_{1,26} = 7.90$, $P = 0.009$), reaching a maximum of 400 citations in one year. The accumulated number of citations (Fig. 1c) increased exponentially from less than 50 to over 4,000 in 20 years (adj. $R^2 = 0.901$, $F_{1,26} = 24.69$, $P < 0.001$).

PPG Biologia published papers mostly with authors from other Brazilian institutions, but also with authors from another 34 countries. USA and Argentina were the countries with the largest numbers of papers co-authored with Unisinos researchers after Brazil, followed by the United Kingdom, Chile, Spain and Germany (Fig. 2, Suppl. material 1). Most frequent publications predominated in research lines of biological sciences, ecology, sociology, education, environmental sciences and genetics, but were spread through a diverse range of lines (Fig. 2b).

Keyword analysis (Fig. 3) revealed a predominance of studies dealing with animals, behaviour, ecosystems, biodiversity, genetics and populations; other less frequent words showed a wide range of studied topics. The keyword

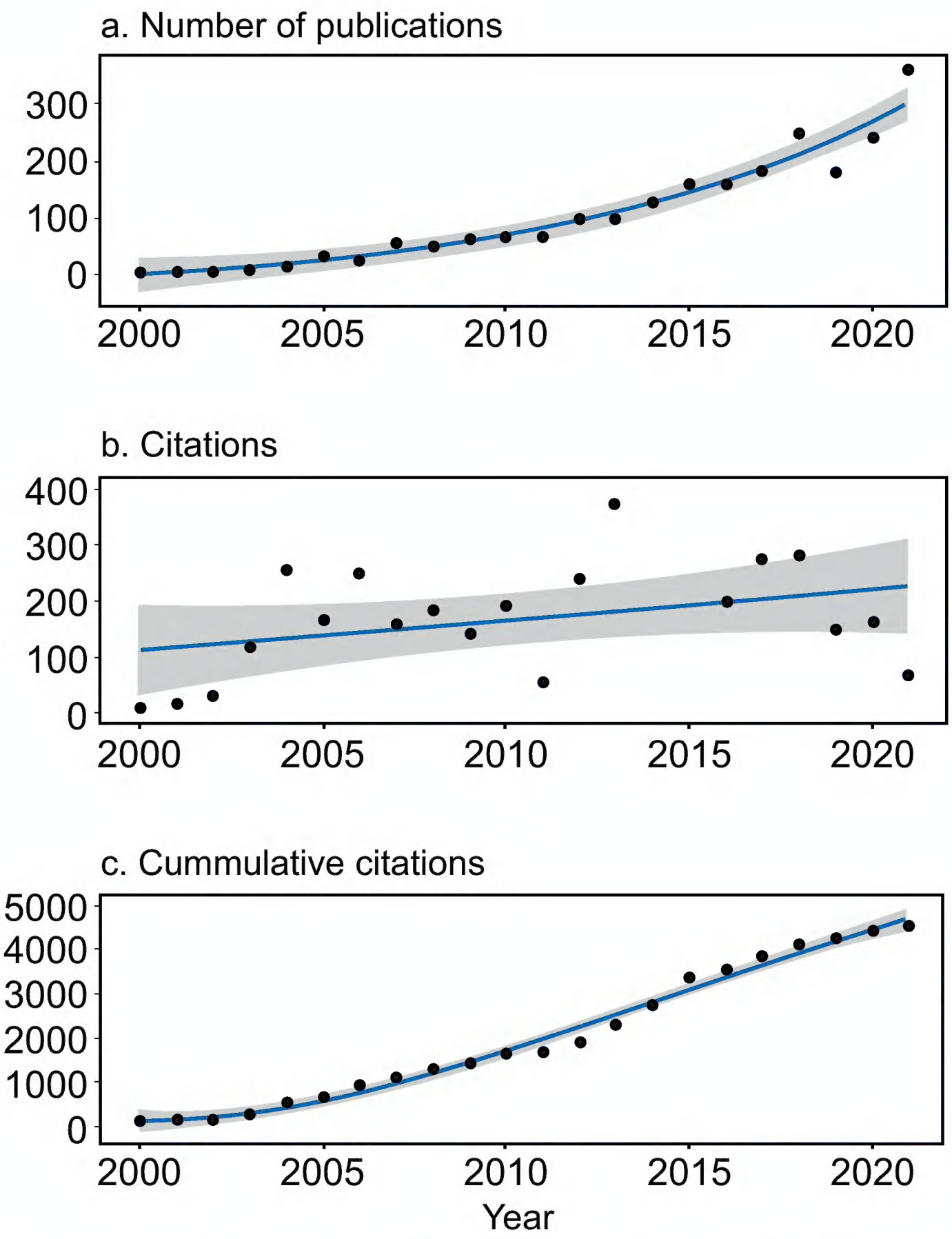

Figure 1. Number of publications mentioning "Programa Pós-graduação Biologia Unisinos" (**a**), number of citations per year of those same papers (**b**); and accumulated citations (**c**) of those papers between 2000 and 2021.

"Brazil" was also highlighted; "south" and "America" also appeared, but with a lower frequency.

Biology PGs in Brazil have a median performance classification (lower 5%, upper 95%) of 4 (3,7) and a mean performance of 4.5 ± 0.25 (SE). The recent performance of Unisinos' PPG Biologia was 5, above the median performance of Brazilian private institutions (W = 258, P = 0.006) and similar to the public institutions (W = 775.5, P = 0.558) (Fig. 4).

Discussion

During its almost 22 years of existence, PPG Biologia showed an exponential increase in productivity. Even in the face of the severe budget cuts in Brazilian research following the impeachment of President Dilma Rousseff in 2016 and

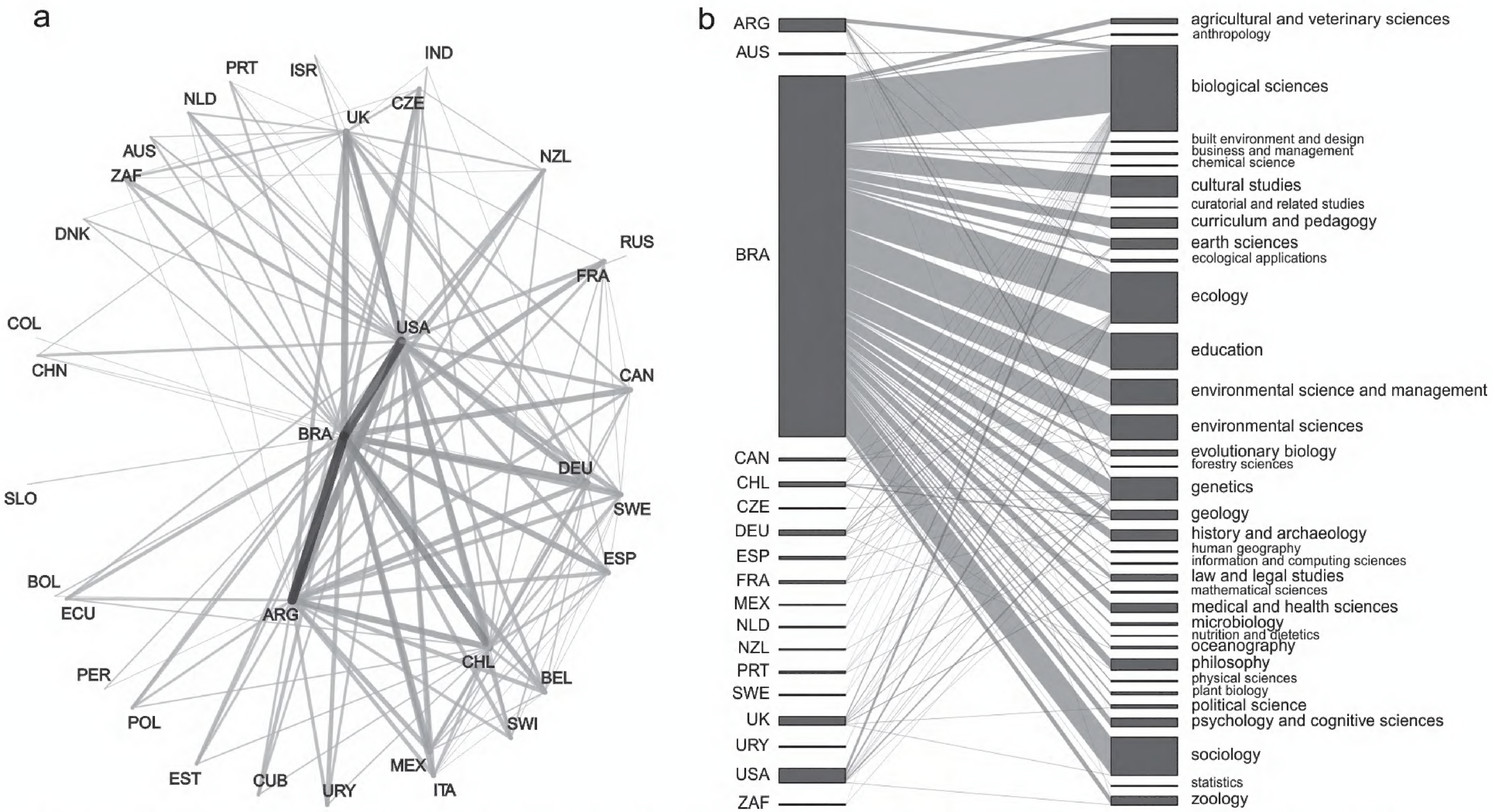

Figure 2. Network of the nationality of co-authors' institutions for papers published by researchers from the Unisinos Postgraduate Program in Biology between 2015 and 2021, including only countries with more than two publications (**a**) and a bipartite network connecting the nationality of the authors' institutions with the publications' research lines, including only research lines with at least two publications (**b**). Line width in both 'a' and 'b' represents frequency; bar height in 'b' indicates the frequency of countries (left) and research lines (right). Countries are indicated by their ISO 3166-1 alpha-3 codes.

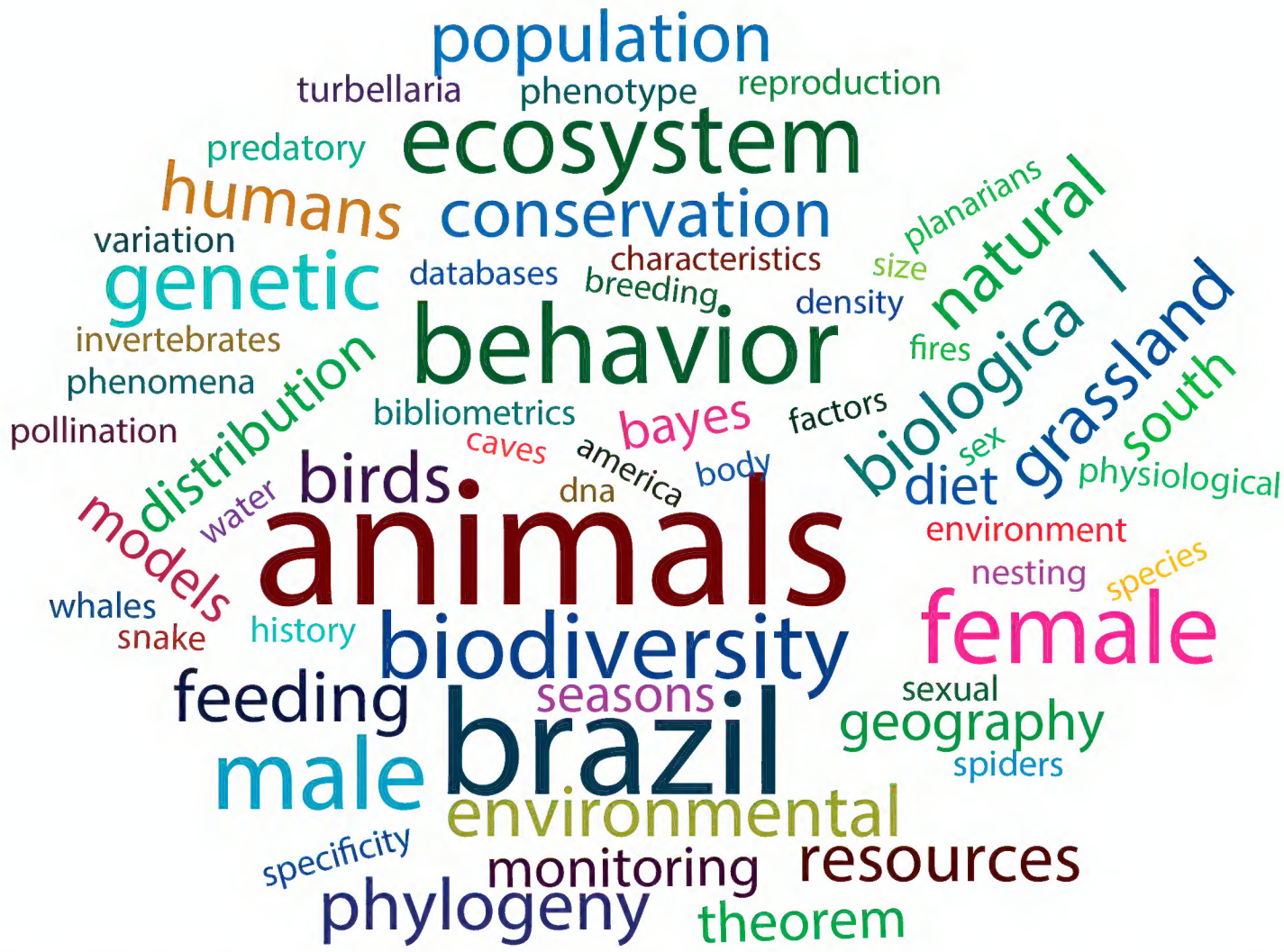

Figure 3. Wordcloud highlighting the most frequent keywords mentioned by publications from the Unisinos Postgraduate Program in Biology between 2015 and 2021.

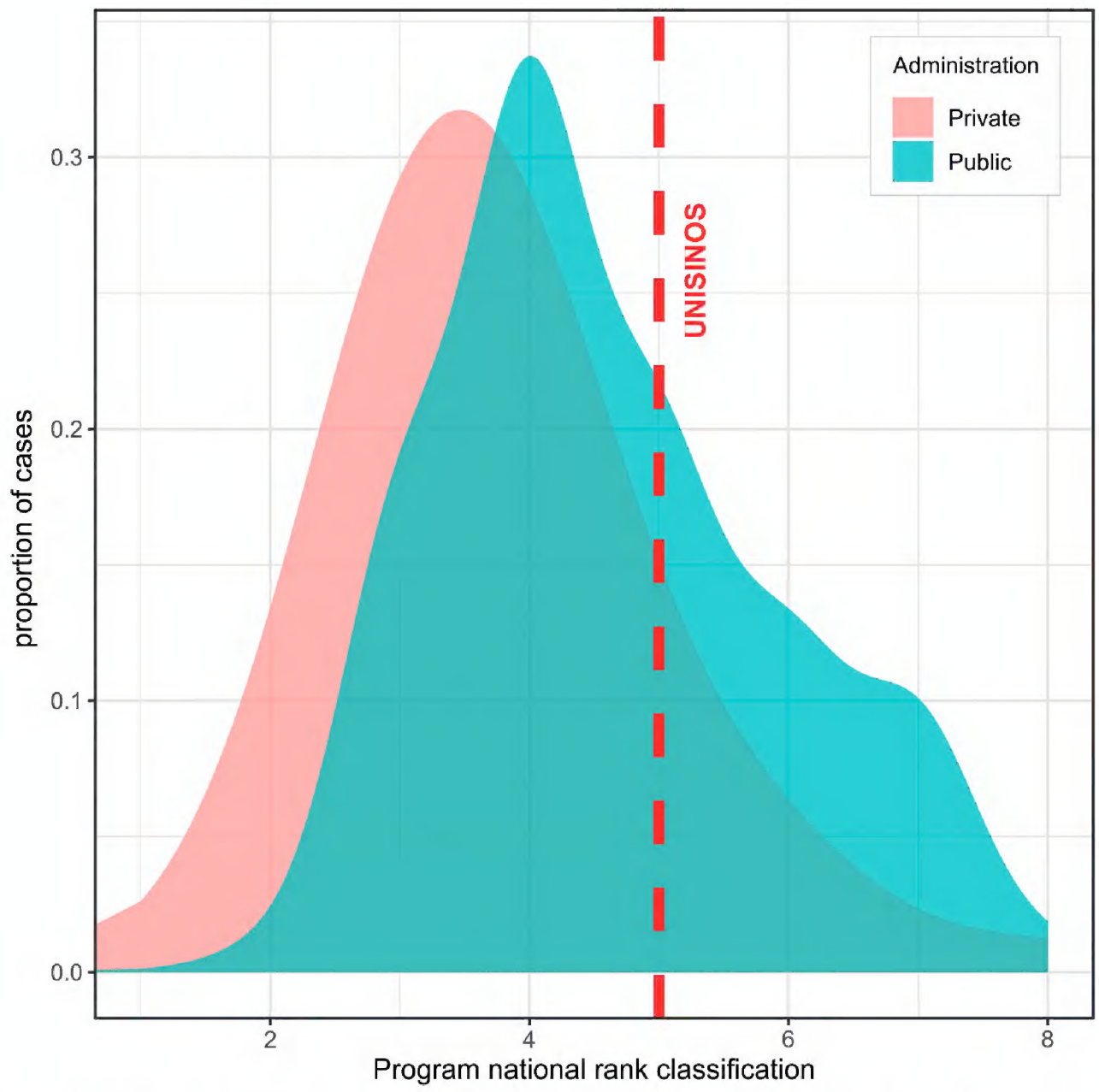

Figure 4. Frequency distribution of national rank classification for Brazil's Postgraduate Programs in Biological Sciences classified as public (blue) and private (red) administration between 2015 and 2020 in relation to the current classification of Unisinos' Postgraduate Program in Biology.

the election of Jair Bolsonaro in 2018 (Quintans-Júnior et al. 2020), the productivity kept growing, which suggests that PPG Biologia was a resilient research programme. The number of citations showed a smaller increase across the years, but the overall small trend may result from a considerable reduction in citations in the last few years, especially since 2019, the first year of the Bolsonaro government. If one considers it as true that the number of citations determines the quality of research, which is a controversial topic (Caon et al. 2020), this may be the metric that reflects the consequences of both budget cuts from funding agencies and the gradual reduction in the number of researchers in PPG Biologia, which started with the gradual dismissal of professors since 2016 (personal observation). As a result, although the number of publications continued to increase, the research areas covered by PPG Biologia decreased, thus reducing the research fields that would find relevant studies amongst the most recent productions of PPG Biologia, leading to fewer citations.

Although PPG Biologia conducted most studies with other Brazilian researchers, collaborations with researchers in other countries from at least four continents and covering a diversity of research lines also stood out. The reasons for international collaborations in research are numerous, but often motivated by the researcher's reputation, access to research funds and an increase in quality and multidisciplinarity due to the expertise of collaborators (Dusdal and Powell 2021). Many researchers of PPG Biologia are renowned experts in their fields and the research groups of PPG Biologia included several research lines addressing globally relevant topics related to genetics and evolution (Silva et al. 2021; Allgayer et al. 2022), taxonomy of highly diverse Neotropical groups (Rodrigues et al. 2020, 2021; Hellmann et al. 2022; Marques et al. 2022; Reis and Lehmann 2022), as well as the dynamics of ecosystems, communities, and populations (Boll and Leal-Zanchet 2018; Fontoura et al. 2019; Moser et al. 2022), including the study of human impact through pollution (Dalzochio et al. 2018; Preuss et al. 2020; Finger et al. 2021; Bauer et al. 2022), agriculture (Meneghel et al. 2022), habitat fragmentation (Baldissera et al. 2020; Dalmolin et al. 2023) and climate change (Fontana et al. 2018; Krüger et al. 2018; Epele et al. 2022). One can notice this diversity in research lines through the most frequent keywords in recent publications.

CAPES score to evaluate Brazilian Postgraduate Programs ranges between 1 and 7, with 6 and 7 indicating excellence (and achieved by very few programmes) and 1 and 2 meaning that the programme is discredited. Thus, the most realistic score for any active postgraduate programme varies from 3 to 5. Although this evaluation system is often questioned and has its flaws (Barata 2019), it is impressive that PPG Biologia was able to keep the highest realistic score in the face of the ever-growing attacks that it received through the reduction of research funds and the gradual decrease in the number of researchers. This is even more impressive considering that PPG Biologia was part of a private university, Unisinos and the overall scores of programmes in private universities are lower than those of public universities. This difference in scores between public and private institutions is likely explained by the fact that private universities invest very little in research and rely almost exclusively on public funding (McManus and Baeta Neves 2021).

Unisinos is a Jesuit university and recognised by Brazilian education agencies as a non-profit entity interested in academic excellence and the promotion and development of education. However, not only did it discontinue 12 postgraduate pro-

grammes and dismissed about 40 professors at once, but started a controversial partnership with a large firearm company in 2021 (Rede Brasil Atual 2022). Such attitudes do not seem to agree with the principles that Unisinos supposedly holds.

Conclusion

Despite the constant attacks through budget cuts and reduction of personnel, PPG Biologia was able to keep its high-quality score over the years. With a research team including renowned researchers and encompassing a diversity of relevant research lines, it showed a promising future as a promoter of knowledge and conservation of Neotropical ecosystems. Unfortunately, this future was denied by the sudden decision of an allegedly non-profit institution to favour profit over research, education and nature conservation.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

Funding

No funding was reported.

Author contributions

LK conceived the study and analysed data. PB lead the manuscript writing with inputs from LK.

Author ORCIDs

Piter Kehoma Boll https://orcid.org/0000-0002-3029-0841
Lucas Krüger https://orcid.org/0000-0003-4637-5302

Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.

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Supplementary material 1

Most common countries from which researchers coauthored publications by Unisinos' Postgraduate Program in Biology

Authors: Piter Kehoma Boll, Lucas Krüger

Data type: occurences

Explanation note: Number of publications per country that had coauthors in publications by Unisinos' Postgraduate Program in Biology.

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